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PRELIMINARY ASSESSMENT OF TWO SAMPLES OF CLAY FROM NEW BRUNSWICK

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by

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ABSTRACT

Two samples, Sample A and B of kaolinitic sand from New Brunswick were evaluated as possible source material for filler or coater-grade kaolin. Process evaluation included wet and dry screening of the coarse +44 µm material and sizing by sedimentation of the -44 µm material. Each size fraction was analysed chemically, and for semi-quantitative mineral content by X-Ray diffraction. A flotation concentrate from a test conducted with Sample A material was acid leached to improve brightness.

Kaolin concentrates in the -10 µm size range of both Sample A and B; the concentration in Sample A was higher at 31.7% Al_2O_3 which corresponds to approximately 80% kaolin. The brightness values of the -10 µm size fractions are very low due to the presence of relatively high quantities of iron minerals (2.35% Fe_2O_3 for Sample A and 11.89% Fe_2O_3 for Sample B).

Acid leaching increased the brightness of a flotation concentrate obtained with Sample A to 62.9%, and the -5 + 2 µm portion of Sample A head sample to 58.0%.

It is unlikely that kaolin from these two samples would be suitable as either filler or coater-grade kaolin due to low brightness values, even after extensive processing and leaching.

Keywords: clay, processing, flotation, acid leaching and brightness

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ÉVALUATION PRÉLIMINAIRE DE DEUX ÉCHANTILLONS D'ARGILE PROVENANT DU NOUVEAU-BRUNSWICK

par

P.R.A. Andrews

RÉSUMÉ

On a évalué deux échantillons de sable kaolinitique provenant du Nouveau-Brunswick, soit les échantillons A et B, en tant que produit d'apport ou de revêtement. Aux fins de l'évaluation, on a effectué le criblage de la matière grossière de +44 µm, par voie sèche et par voie humide, et le calibrage par sédimentation des fractions de -44 µm. Chaque fraction granulométrique a été soumise à une analyse chimique et à une analyse semi-quantitative par diffraction des rayon X afin d'en déterminer le contenu minéral. On a lixivié à l'acide un concentré de flottation provenant d'un essai avec de la matière de l'échantillon A, pour en améliorer la brillance.

Le kaolin se concentre dans les particules de -10 µm des échantillons A et des échantillons B; la concentration dans l'échantillon A était supérieure à 31,7 % Al_2O_3, ce qui correspond à environ 80 % de kaolin. Les valeurs de brillance des fractions de -10 µm sont très basses en raison de la présence de quantités relativement élevées de minerai de fer (2,35 % Fe_2O_3 dans l'échantillon A et 11,89 % Fe_2O_3 dans l'échantillon B).

La lixiviation à l'acide a accru la brillance d'un concentré de flottation obtenu à partir de l'échantillon A jusqu'à 62,9 % et celle de la fraction -5 + 2 µm du concentré de l'échantillon A jusqu'à 58,0 %.

Il est peu vraisemblable que le kaolin provenant de ces deux échantillons convienne soit comme produit d'apport ou de revêtement en raison des valeurs de brillance peu élevées, et ce, même après un traitement et une lixiviation rigoureux.

Mots-clé : argile; traitement; flottation; lixiviation à l'acide; brillance ou luminance.

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INTRODUCTION

In February 1988, two samples of clay were received from Venus and Associates, Geological Consultants, Fredericton, New Brunswick. The samples as received, designated as WAL-88 and L-17/87 were obtained from the central part of the province. For ease of reference, Sample WAL-88 was designated as Sample A and L-17/87 as Sample B. The approximate weight of each is as follows:

Sample A 5.5 kg
Sample B 1.3 kg

SCOPE OF STUDY

Due to the small weight of each sample only a preliminary assessment was made. This involved a brief mineralogical study restricted to mineral identification; beneficiation included sizing down to 2 µm with chemical analysis and brightness determinations of each fraction to determine the suitability for filler use. Additional beneficiation to improve the grade of clay using flotation was conducted only on Sample A; there was insufficient weight of Sample B.

HEAD SAMPLE

A 500 g portion of each sample was wet screened at 25 µm. The oversize was dry screened from 315 µm to 25 µm, and the undersize separated at 25, 15, 10, 5 and 2 µm by decantation. Each fraction after drying was analysed by X-Ray fluoresence for SiO_2, Al_2O_3, Fe_2O_3, TiO_2, CaO and MgO. Brightness determinations of the -25 µm to -2 µm size fractions were conducted with a Photovolt 577 reflection meter using $BaCO_3$ as a standard. Product balances for Sample A are reported in Table 1, for Sample B in Table 2 and brightness determinations in Table 3.

Mineralogical information on several size fractions was obtained by X-Ray diffraction; diffractograms for Sample A are presented in Fig. 1 and 2, for Sample B in Figs 3 and 4. A qualitative assessment of major and

minor minerals by size fraction for Sample A is presented in Table 4 and for Sample B in Table 5.

PROCESSING

Flotation

The remaining portion of Sample A was crushed to pass 6 mm and mixed in an attrition scrubber at 75% solids for 30 min to separate the agglomerated clay from coarse silica. The attrition product was wet screened at 210 µm and 44 µm to separate coarse and fine silica. The -44 µm clay fraction, after settling, was decanted and divided into two portions for flotation evaluation.

Two clay flotation tests were conducted; Armac T, tallow amine acetate collector was used in the first test and Duomeen TDO, tallow diamine propane dioleate collector in the second test. Each test was conducted at pH 2 and stage addition of collector was necessary to minimize the flotation of silica fines. Product balances of flotation tests are reported in Table 6 and reagent concentration data in Table 7.

Acid Leaching

Two leaching studies were conducted with Sample A material to increase the brightness of high grade products: the flotation concentrate from Test 2 and the -5 + 2 µm portion of the decanted head sample. Twenty-five gram portions of each product were acid leached for 5 hours at 80°C with 50% HCl. After the first five hour leach the solution was decanted, the solids washed, fresh acid added and the solids leached for a further five hours. After leaching, the upgraded products were retested for brightness and re-analysed for Fe_2O_3.

RESULTS

An analysis of 31.7% Al_2O_3 for the -10 µm fraction of Sample A indicates that kaolin is concentrating in the -10 µm size ranges. This trend is supported by the X-Ray diffraction data in Table 4. The weight

percent in this size range is low at 25.9% and the brightness values are also low at between 30.5% and 36.7%. These low brightness values are due to the presence of 2.35% Fe_2O_3.

The concentration of kaolin in Sample B is constant at approximately 25% Al_2O_3 in the -15 µm size ranges, which is less than the corresponding size fraction for Sample A. The weight percent of the -10 µm fraction at 33.7% is low and the brightness values of the -10 µm size ranges are also low, between 16.5% and 20.6% due to the presence of 11.89% Fe_2O_3.

Further beneficiation to increase the concentration of kaolin was conducted only with Sample A material; Sample B was considered to be too high in Fe_2O_3 to warrant further investigation. The product balances of the two flotation tests in Table 6 show some concentration but at very low recoveries.

Acid leaching of the flotation concentrate from Test 2 increased the brightness value from 25.4% to 62.9% and reduced Fe_2O_3 to 0.68%; the -5 + 2 µm portion of the decanted head sample from 34.0% to 58.0% and reduced Fe_2O_3 to 0.60%.

CONCLUSIONS

Kaolin concentrates in the -10 µm size range of both Sample A and B; the concentration in Sample A is higher at 31.7% Al_2O_3, which corresponds to approximately 80% kaolin. The brightness values of the -10 µm size fractions of each sample are very low due to the presence of relatively high (2.35% Fe_2O_3 for Sample A and 11.89% for Sample B) quantities of iron minerals. Acid leaching increased the brightness of a flotation concentrate obtained with Sample A to 62.9%, and the -5 + 2 µm portion of Sample A head sample to 58.0%. It is unlikely that kaolin from these two samples would be suitable as either filler or coater grade kaolin due to these low brightness values.

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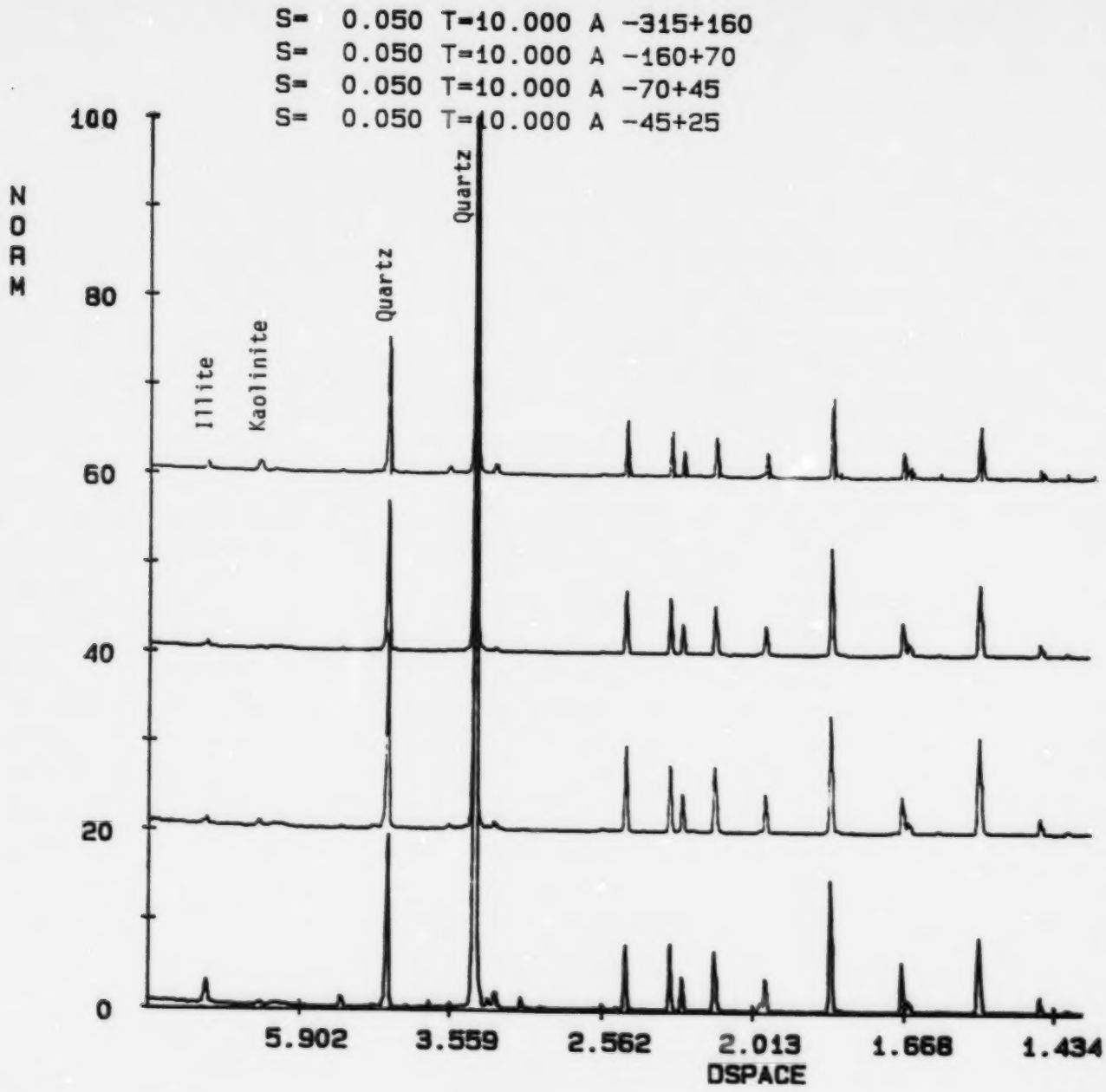

Fig. 1 - X-Ray diffraction patterns for +25 μm Sample A products.

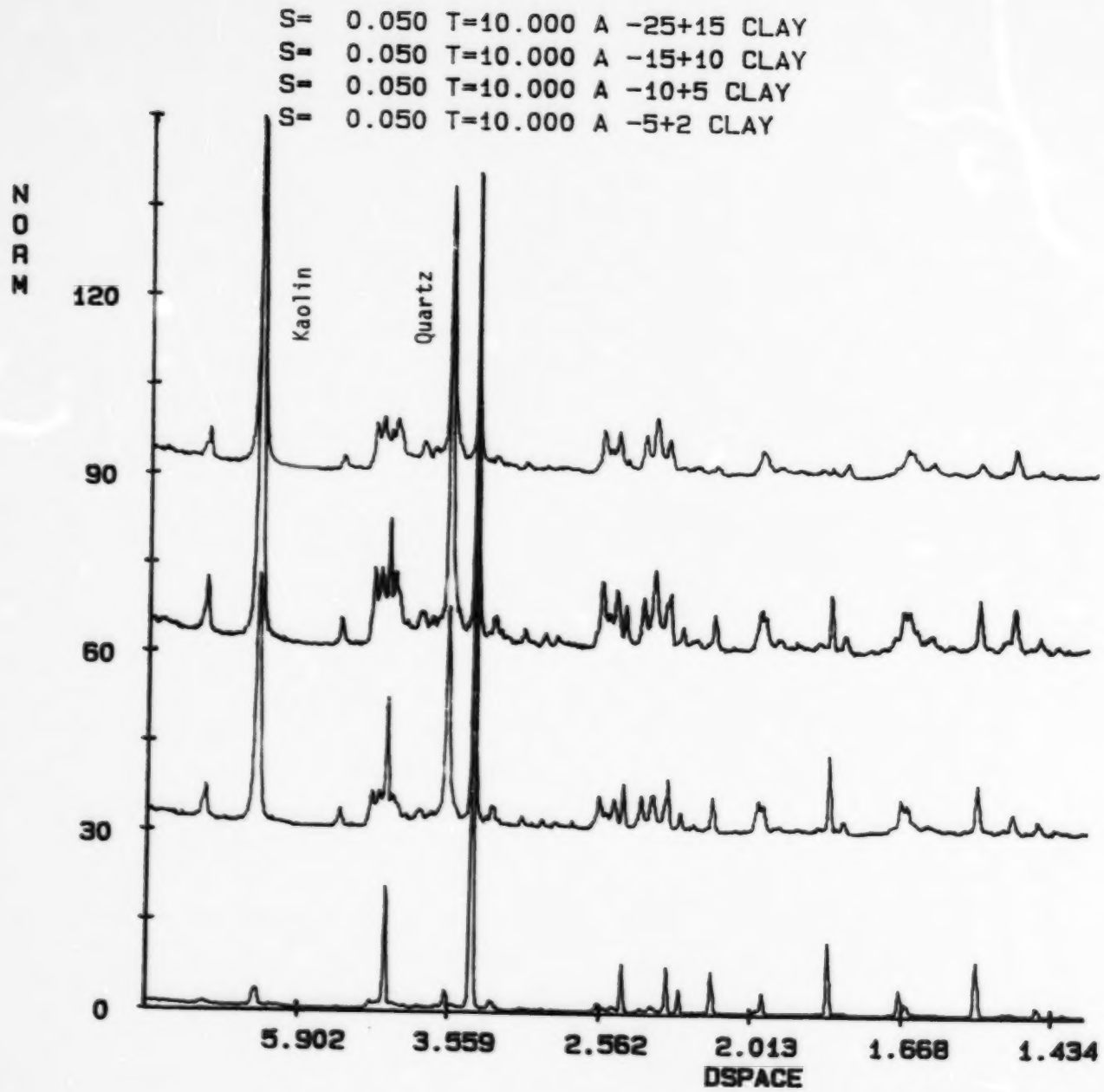

Fig. 2 - X-Ray diffraction patterns for -25 μm Sample A products.

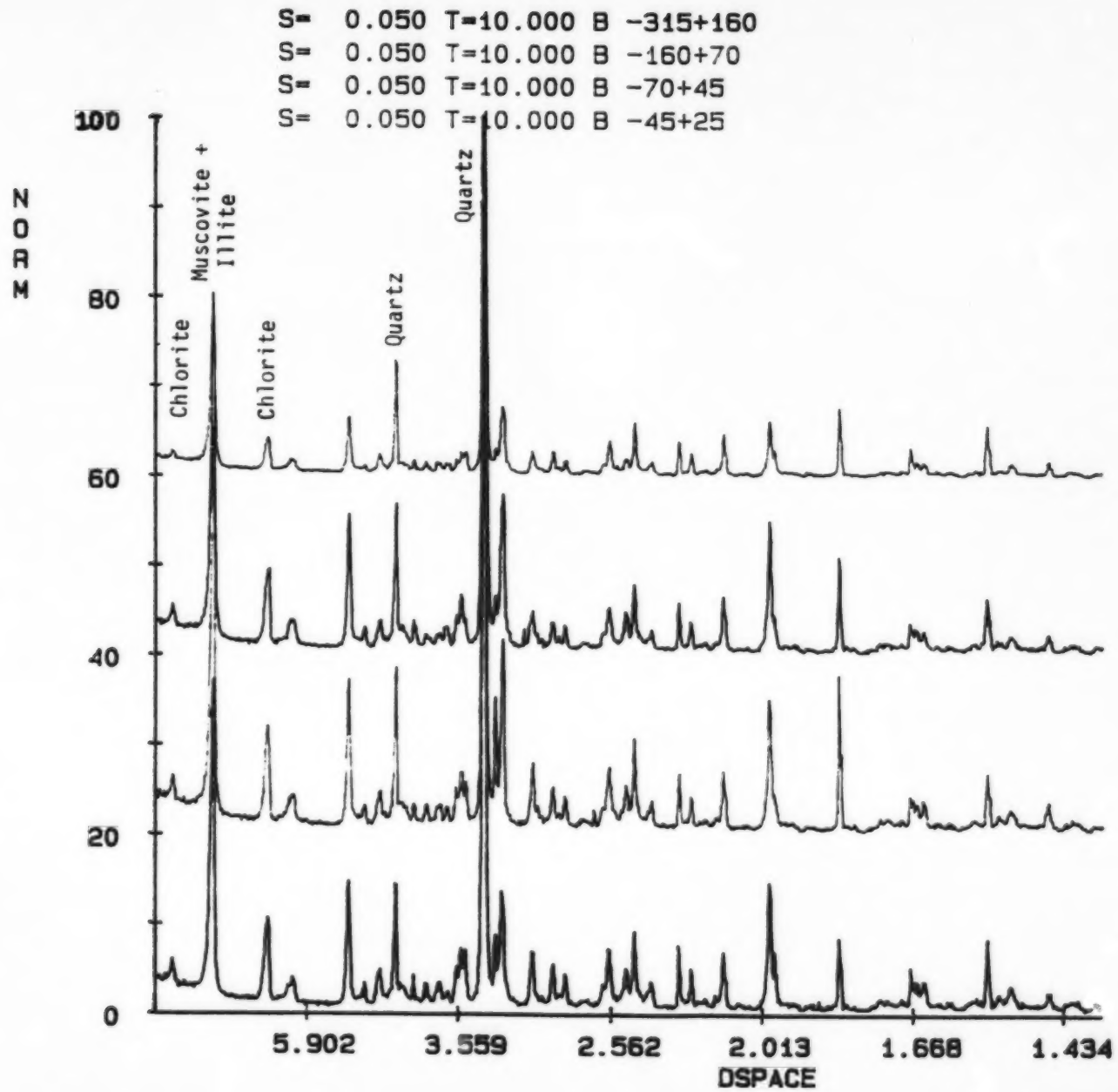

Fig. 3 - X-Ray diffraction patterns for +25 μm Sample B products.

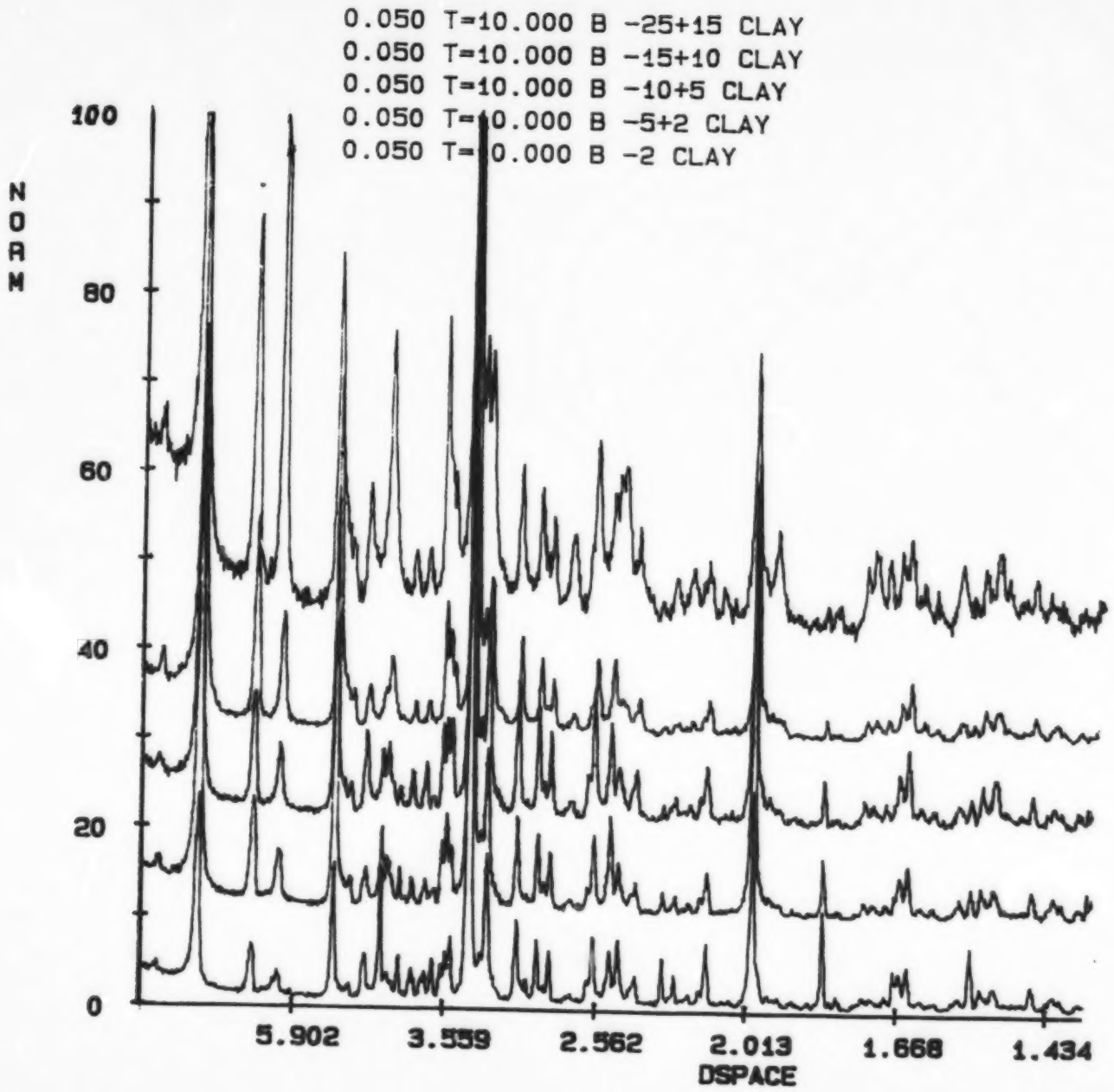

Fig. 4 - X-Ray diffraction patterns for -25 μm Sample B products.

Table 1. Sample A head sample size analysis and product balance

Size fraction µm	Wt %	Analysis %				Distribution %			
		Al_2O_3	Fe_2O_3	TiO_2	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	SiO_2
+315	5.8	4.50	1.72	0.20	86.2	2.3	9.0	2.2	7.0
-315 +160	8.6	2.27	0.51	0.12	79.3	1.7	3.9	1.8	9.5
-160 + 70	25.6	2.03	0.39	0.64	77.2	4.5	9.0	29.7	27.6
- 70 + 45	11.9	1.73	0.40	0.68	88.1	1.8	4.3	14.6	14.7
- 45 + 25	10.7	3.68	0.54	0.61	86.3	3.4	5.2	11.8	12.9
- 25 + 15	6.2	9.12	1.19	0.86	80.2	4.8	6.6	9.6	7.0
- 15 + 10	5.3	22.6	1.63	0.64	56.5	10.4	7.7	6.1	4.2
- 10 + 5	7.3	28.9	1.85	0.58	51.8	18.3	12.1	7.6	5.3
- 5 + 2	15.3	33.1	2.48	0.50	45.3	43.8	33.9	13.9	9.7
- 2	3.3	31.4	2.83	0.46	44.6	9.0	8.3	2.7	2.1
Head (calculated)	100.0	11.55	1.12	0.55	71.5	100.0	100.0	100.0	100.0

Table 2. Sample B head sample size analysis and product balance

Size fraction µm	Wt %	Analysis %				Distribution %			
		Al_2O_3	Fe_2O_3	TiO_2	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	SiO_2
+315	22.2	16.8	12.0	0.86	55.5	17.9	25.7	17.2	24.4
-315 +160	7.5	17.8	11.0	0.96	54.4	6.4	8.0	6.5	8.1
-160 + 70	7.0	16.9	10.7	1.16	54.2	5.7	7.2	7.3	7.5
- 70 + 45	3.5	16.0	9.87	1.24	58.4	2.7	3.3	3.9	4.1
- 45 + 25	4.6	15.4	6.71	1.24	62.7	3.4	3.0	5.1	5.7
- 25 + 15	10.2	19.1	6.05	1.20	56.2	9.4	6.0	11.0	11.4
- 15 + 10	11.3	24.0	7.49	1.10	48.1	13.0	8.2	11.2	10.8
- 10 + 5	11.9	25.6	8.17	1.09	46.1	14.6	9.4	11.7	10.9
- 5 + 2	10.7	26.5	10.2	1.27	42.7	13.6	10.4	12.3	9.1
- 2	11.1	25.0	17.5	1.38	36.3	13.3	18.8	13.8	8.0
Head (calculated)	100.0	20.8	10.36	1.11	50.4	100.0	100.0	100.0	100.0

Table 3. Brightness determinations for various size fractions

Size fraction µm	A	B
-315 +160	34.6	14.6
-160 + 70	43.7	15.7
- 70 + 45	42.3	17.6
- 45 + 25	43.7	20.2
- 25 + 15	37.5	22.1
- 15 + 10	38.6	22.0
- 10 + 5	36.7	20.6
- 5 + 2	34.0	20.1
- 2	30.5	16.5

Table 4. Qualitative mineral composition for Sample A

Size fraction μm	Description
-315 + 160	Major quartz with minor illite
-160 + 70	Major quartz with trace illite and kaolinite
- 70 + 45	Major quartz with trace illite
- 45 + 25	Major quartz with trace illite and kaolinite
- 25 + 15	Major quartz, minor kaolinite and trace muscovite
- 15 + 10	Major quartz and kaolinite with minor muscovite
- 10 + 5	Major kaolinite and quartz with minor muscovite
- 5 + 2	Major kaolinite and quartz with minor illite
- 2	Insufficient sample

Table 5. Qualitative mineral composition for Sample B

Size fraction μm	Description
-315 + 160	Major quartz with minor muscovite and illite, and trace chlorite and feldspar
-160 + 70	Same as for -315 +160 μm fraction
- 70 + 45	Same as for -315 +160 μm fraction
- 45 + 25	Same as for -315 +160 μm fraction
- 25 + 15	Major quartz and muscovite with trace chlorite and kaolinite
- 15 + 10	Major quartz and muscovite, minor kaolinite with trace chlorite
- 10 + 5	Major muscovite and quartz, minor kaolinite with trace chlorite
- 5 + 2	Major muscovite and kaolinite with trace quartz and chlorite
- 2	Major muscovite and kaolinite

Table 6. Flotation product balances for Sample A

Test No	Products	Bright. values	Analysis %					Distribution %			
			Wt %	Al_2O_3	Fe_2O_3	TiO_2	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	SiO_2
1.	Final conc.	27.6	1.1	30.5	4.27	0.44	46.9	1.3	1.1	0.9	1.0
	2nd Cl. tails	27.0	8.6	28.1	4.46	0.55	51.0	40.8	39.0	36.7	36.1
	1st Cl. tails	25.6	37.9	26.1	4.25	0.57	53.7	8.6	8.5	8.7	8.6
	Rgh. tails	28.8	52.4	24.6	4.25	0.58	55.6	49.3	51.4	53.7	54.3
	Head (calculated)	-	100.0	26.1	4.33	0.57	53.6	100.0	100.0	100.0	100.0
2.	Final conc.	25.4	4.6	28.9	4.54	0.52	49.1	5.2	4.8	4.2	4.2
	1st Cl. tails	28.3	38.2	26.5	4.40	0.56	52.7	39.3	38.3	37.5	37.3
	Rgh. tails	28.5	57.2	25.0	4.37	0.58	55.2	55.5	56.9	58.3	58.5
	Head (calculated)	-	100.0	25.8	4.39	0.57	54.0	100.0	100.0	100.0	100.0

Table 7. Flotation parameter and reagent concentration data

Test No	Float. Stage	No of stages	Cond. Time	Float. Time	pH	Collectors		Frother D-250
						Arm. T	Duo. TDO	
			min.	min.		g/t	g/t	g/t
1.	Rougher	5	20	26	2.05	326.5	-	15.4
	Cleaner	2	10	10	2.00	81.6	-	-
2.	Rougher	5	20	26	2.00	-	355.5	33.6
	Cleaner	1	4	6	1.98	-	142.3	-